LINKTROPY® MINI² WAN EMULATOR

USER'S GUIDE

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elexo

Groupe Bull

APPOSITE® TECHNOLOGIES

Linktropy® Mini² WAN Emulator User's Guide

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ELEXO
20 Rue de Billancourt
92100 Boulogne-Billancourt
Téléphone : 33 (0) 1 41 22 10 00
Télécopie : 33 (0) 1 41 22 10 01
Courriel : info@elexo.fr
TVA : FR00722063534

Apposite® Technologies, Inc.
11500 W. Olympic Blvd., Suite 510 tel: 1.310.477.9955
Los Angeles, CA 90064 USA fax: 1.310.477.9956
www.apposite-tech.com email: info@apposite-tech.com

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1 | OVERVIEW

Thank you for purchasing the Apposite Technologies Linktropy Mini² WAN Emulator. This *User's Guide* describes the installation, configuration, and operation of the Linktropy functionality. Please consult the companion *Hardware Guide* for information on the Linktropy Mini² hardware. A separate *Quick Start Guide* provides a walk-through for first time configuration.

Linktropy Product Family

The Linktropy Mini² is a portable, low cost member of the Linktropy WAN Emulator product family, designed primarily to emulate basic WAN conditions for customer demonstrations of networking products and application development of client/server systems. Its small size and light weight make it easy to carry, while its fanless design and solid-state storage offer extra reliability for frequent shipping. Other than the ultra-compact form factor of the Mini², the Linktropy Mini and Mini² are identical in functionality and performance.

The Linktropy Mini and Mini² are not designed to provide the same level of precision, performance, and functionality as the Linktropy 5500 and 8500 which are built as professional test tools for lab testing and product validation. The table on the next page shows the matrix of features for the different products in the Linktropy product family.

Linktropy Model	Mini & Mini2	5500	8500
Performance			
Maximum throughput per link (full duplex)	100 Mbps	1 Gbps	1 Gbps
Emulated links	1	1	4
Maximum packet forwarding rate (pps)	80,000	1 million	12 million
Test lab level precision	X	✓	✓
Jumbo Frame Support (up to 9 KB)	X	✓	✓
Link Impairment Emulations			
Bandwidth	✓	✓	✓
Latency (constant, uniform, and normal distributions)	✓	✓	✓
Packet Loss	✓	✓	✓
Bit Errors	✓	✓	✓
Background Traffic	X	✓	✓
Packet Duplication	X	✓	✓
Packet Reordering	X	✓	✓
Live condition capture and replay	X	✓	✓
Linktropy Scheduler for dynamic conditions	X	✓	✓
Installation			
Record and download traffic statistics	X	✓	✓
Install as Bridge	✓	✓	✓
Install as Router	✓	✓	✓
Emulation interfaces	2 FE 10/100baseT	2 GigE RJ45 or SFP	8 GigE RJ45 or SFP
Form factor	compact	1U	1U
Hardware warranty and software maintenance	1 year	1 year	1 year
Customer support	90 days	1 year	1 year

Linktropy Operation

The Linktropy Mini² emulates a wide area network link between two local networks. Depending on configuration, the Linktropy device is installed as either a bridge or a router between the Ethernet segments connected to the LAN A and LAN B ports of the unit. Frames received on one port are subjected to the emulated WAN conditions before being forwarded to the opposite port.

Frames are processed by the Linktropy WAN Emulator in the following steps:

1. Ethernet frames arrive on the LAN A or LAN B interface of the Linktropy Mini².

2. The effective size of the frame is calculated as the data portion of the Ethernet frame (without the Ethernet header or FCS) plus the configured value for framing overhead.

3. Frames are throttled to the specified WAN bandwidth. Frames in excess of the specified WAN bandwidth are queued to the configured maximum queue depth. When the queue is full, newly-arriving frames are discarded.

4. Frames are subjected to random discard based on the configured packet loss and bit error parameters.

5. Frames remaining after the discard procedure are held for the specified link delay. Frames are not reordered in this step, even if subjected to differing delays. For example, if the delay is specified as a uniform distribution between 10 and 100 ms and the first frame is subjected to a 90 ms delay and the second frame is subjected to a 20 ms delay, the second frame can not be transmitted until after the first frame has been transmitted. This effect can skew the measured mean delay to be higher than the configured value when using a normal or uniform distribution.

6. Frames are bridged or routed to the opposite LAN interface and transmitted to the destination address.

Frames are subject to three separate delays:

1. Propagation delay: Delay caused by the distance the signal travels. This delay is emulated as the specified link delay.

2. Queuing delay: If frames arrive faster than they can be transmitted over the WAN link, they are held awaiting their slot for transmission. The actual queuing delay will vary depending on how quickly frames arrive compared to how quickly they can be transmitted. The maximum queuing delay is determined by the maximum queue depth, which can be set in milliseconds, bytes, or packets.

3. Transmission delay: The time to transmit the individual bits in each frame is an additional delay that can be significant for large frames over low speed links. For example, the transmission of a

1500 byte frame over a 9,800 bps link adds 1.25 seconds. The transmission delay is fixed by the frame size and link bandwidth.

Only the propagation delay is specified directly as an emulation parameter. The end-to-end delay is the sum of the three individual delays.

Frames are subject to three separate types of loss:

1. Emulated packet loss: Frames are randomly discarded based on the specified packet loss rate. Since frame discard occurs after the frames have been rate throttled, discarded frames will consume link bandwidth.

2. Emulated bit errors: Frames are randomly discarded based on the specified bit error rate. Since this discard also occurs after the frames have been rate throttled, discarded frames will consume link bandwidth.

3. Queue drops: If frames arrive faster than they can be transmitted over the emulated link, excess frames will be queued to the specified maximum queue depth. Once the queue is full, additional frames are discarded. These dropped frames do not consume WAN bandwidth.

When functioning as a bridge, the Linktropy WAN Emulator is not limited to emulating IP networks, but can emulate any type of network so long as the traffic is encapsulated in Ethernet. In addition to IP, the device can be used with IPv6, IPX, AppleTalk, SCPS, and proprietary network and transport layer protocols.

Linktropy Configuration

Configuration of the Linktropy Mini² WAN Emulator is primarily through the browser-based Linktropy GUI (Graphical User Interface). The GUI is accessible from any PC or other device with a standard web browser. Management connectivity is via a dedicated Ethernet management interface on the Linktropy WAN Emulator or in-band through the LAN A or LAN B interface. See Section 3 for more information on the Linktropy GUI.

In addition to the GUI, the Linktropy WAN Emulator includes a limited command line interface (CLI) that can be accessed via the console serial port or over the network using Telnet. The CLI is used primarily to set the management IP address if the GUI is not accessible over the network, and to load stored emulation conditions for use with script-based automated testing. See Section 10 for details on the CLI.

2 | GETTING STARTED

Installing the Linktropy Mini² WAN Emulator

The Linktropy Mini² is managed through a browser-based GUI over an Ethernet connection to a dedicated management interface. Prior to operation, this management interface must be configured with appropriate network settings, either through the Linktropy GUI or through the command-line interface accessed via the serial console. For convenience, the management interface comes preconfigured with an IP address of 10.0.0.10, and the GUI is accessible from a directly-connected host on the 10.0.0.0/255.0.0.0 subnet.

Preparation

Management of the Linktropy Mini² requires a PC running a supported web browser (Internet Explorer v6 or later, Mozilla Firefox, or Google Chrome). JavaScript must be enabled.

Initial configuration of the management interface requires either:

- a PC running a supported web browser that can be configured and placed on the 10.0.0.0/255.0.0.0 network.
- a PC with an RS-232 serial port running terminal emulation software such as HyperTerminal or PuTTY.

Hardware Installation

Plug in the supplied AC to DC power adaptor to the DC power input on the back of the unit. The Power LED on the front panel will glow green and the system will be available for use within 60 seconds.

IP Address Configuration via the Linktropy GUI

To configure the management interface using the Linktropy GUI:

1. Configure a PC running a supported web browser with an IP address on the 10.0.0.0/255.0.0.0 subnet.

2. Connect an Ethernet cable between the PC and the MGMT port of the Linktropy Mini².

3. Open the browser on the PC and enter http://10.0.0.10 (the preconfigured management address) in the address bar. The Linktropy End User License Agreement will be displayed in a separate window.

4. Review the License Agreement. The Linktropy GUI will be displayed once the License Agreement is accepted.

5. The Linktropy GUI will open to the **Device Settings** tab. If desired, modify the IP address, netmask, and default gateway for the management interface. Click the *Apply Changes* button when done.

IP Address Configuration via the Serial Console

Using the provided DB-9 cable, connect the serial port of a PC running terminal emulation software to the CONSOLE port of the Linktropy Mini². Set the serial port parameters to 9600 baud, 8 bits, no parity, 1 stop bit, and disable flow control. For more details on connecting to the serial console, see the *Linktropy Mini² Hardware Guide*.

Press `[ENTER]` to display a login prompt. At the prompt, log in as "`admin`". There is no password.

```
linktropy login: admin
```

Use the following commands to set the IP address, IP netmask, and default gateway of the Linktropy Mini² management interface:

```
mgmt set addr <interface-ip-address> netmask <ip-netmask>
mgmt set gw <default-gateway>
```

IP addresses and netmasks are entered in dotted-decimal format. For example:

```
linktropy> mgmt set addr 192.168.1.1 netmask 255.255.255.0
```

6. Once the management interface has been configured, use the Ethernet cable to connect the MGMT port to the management network.

Operation

Install the Linktropy Mini² between two LAN segments as shown in the diagram. By default, the Linktropy Mini² acts as a bridge between the Ethernet segments connected to the LAN A and LAN B ports. Frames received on one port are

subjected to the emulated WAN conditions before being forwarded to the opposite port.

Emulation conditions for the WAN link are configured in the Linktropy GUI and operate independently in each direction. To set the emulation parameters, use a web browser to connect to the Linktropy GUI at the configured management address. All emulation parameters are found on the **Link Emulation** tab. Emulation is disabled until the red "Emulation On/Off" button at the top of the screen is pressed. See the following chapters for details on Linktropy emulation parameters or click the ℹ buttons on the GUI for information on specific parameters.

3 | LINKTROPY GUI

Overview

The browser-based Linktropy GUI is the primary configuration interface for the Linktropy Mini². The GUI is compatible with Internet Explorer v6 and later, Mozilla Firefox, and Google Chrome. JavaScript must be enabled.

The Linktropy GUI consists of a Configuration window and a Monitor window.

Figure 2: Configuration Window

Figure 3: Monitor Window

The Configuration window contains a set of tabs used to specify the emulation parameters and device settings. Sections 4 through 8 of this *User's Guide* describe each of the individual tabs.

The top portion of the Configuration window also includes the Status Box, Emulation On/Off button, and Message Bar. These elements remain visible across the various tabs.

Each input field of the Configuration window is checked for validity when modified. Valid changes are displayed in bold. Invalid changes are noted with a red box around the field. Additional checks

are performed when the user attempts to apply the changes, and any errors are marked with a red box at that time.

Clicking any info button on the Configuration window brings up a Help window with documentation for the specific field. This *User's Guide* is also accessible from any Help window.

The Monitor window displays real-time statistics and throughput graphs of the traffic traversing the emulated WAN link. See Section 9 for details on the Monitor window.

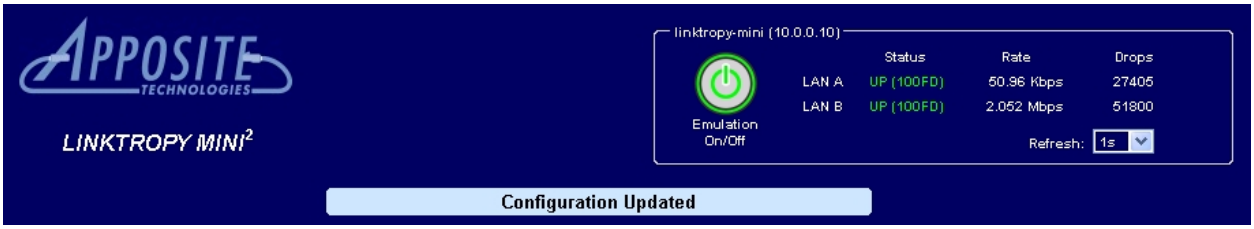

Figure 4: Linktropy Mini² Status Box and Message Bar

Status Box

The Status Box, containing the Emulation On/Off button, interface status, and basic statistics, is located in the top right corner of the Configuration window, and is visible across all tabs.

The Status Box displays the status of the LAN A and LAN B Ethernet interfaces. If the interface is unplugged or fails to negotiate an Ethernet connection, "down" will be displayed in red. During normal operation, the speed and duplex state of the interface are displayed in green.

When emulation is turned on, the Status Box displays the current instantaneous throughput in each direction, averaged over a 1 second interval, and the total number of dropped frames. Statistics are refreshed at the interval set from the drop-down menu in the lower right corner of the Status Box. More detailed statistics and throughput graphs are shown in the separate Monitor window.

Emulation On/Off Button

The Emulation On/Off Button is located on the left side of the Status Box. The button is lit red when emulation is turned off and green when emulation is on. Click the button to toggle between on and off states. The saved configuration is immediately updated when the emulation state is changed.

Emulation is turned off by default when the Linktropy WAN Emulator is first installed.

Message Bar

The Message Bar, located in the center of the screen between the Status Box and configuration tabs, is only visible when status messages are displayed. Confirmation messages are displayed on a blue background. Alert messages are displayed on a red background.

4 | LINK EMULATION TAB

Link Emulation Parameter Configuration

The **Link Emulation** tab contains all of the parameters for link emulation. Each parameter can be configured separately for traffic from LAN A to LAN B and from LAN B to LAN A.

Basic parameter settings are always visible on the **Link Emulation** tab. Advanced parameters, which generally only need adjustment for specialized conditions, are hidden by default. To display the advanced parameters, click the s*how* link. Click the *hide* link to hide them again if desired.

The active configuration is not modified until the *Apply Changes* button at the bottom of the tab is pressed. The *Apply Changes* button is grayed out when there are no changes to apply. It is also grayed out if there are any invalid entries. To return to the active configuration without applying any changes, press the *Clear Changes* button.

When the *Apply Changes* button is pressed, final validation of the configuration is performed. If there are no errors in the configuration, the new configuration will take effect and the message, "Configuration Updated" will be displayed in the Message Bar. If there are any errors in the configuration, a red box will be displayed around the invalid field or an error message will be displayed in the Message Bar.

Advanced parameter settings are used in the emulation, even if the parameters are hidden.

Figure 5: Link Emulation Tab

Basic Parameters

Bandwidth

The Bandwidth row is used to configure the link rate of the emulated WAN.

The link rate is set independently in each direction in increments of 1 bps, with a minimum rate of 300 bps and a maximum rate determined by the purchased license. Entered rates can not have fractional bits per second.

The link rate is set in units of bps, Kbps, or Mbps selected from the drop-down menu next to the rate.

If the entered link rate is not a valid value when the *Apply Changes* button is pressed, a red error box will be drawn around the invalid fields and the changes will not be applied.

> ☞ 1 Kbps is 1,000 bps, not 1,024 bps. Similarly, 1 Mbps is 1,000,000 bps.

Delay

The Delay parameter specifies the link latency in milliseconds, and is set independently for each direction. Delay can be set from 0 milliseconds to 10 seconds. Entered values are rounded to the nearest 0.1 millisecond.

The radio buttons are used to specify the delay distribution:

- Constant: A single, fixed value for delay.
- Uniform: A uniform distribution of delay ranging between the configured minimum and maximum values.
- Normal: A truncated normal distribution curve, with a specified minimum, mean and standard deviation.

If the entered minimum delay is greater than the entered maximum (for a uniform distribution) or mean (for a normal distribution), a red error box will be drawn around the invalid fields when the *Apply Changes* button is pressed and the changes will not be applied.

☞ The round trip time (RTT) of the link is the sum of the delay in both directions.

☞ Using the delay parameter, frames are not reordered even if subjected to differing delays. For example, if the delay is specified as a uniform distribution between 10 and 100 ms and the first frame is subjected to a 90 ms delay and the second frame is subjected to a 20 ms delay, the second frame will not be transmitted until after the first frame has been transmitted. This effect can skew the measured mean delay to be higher than the configured value when using a normal or uniform distribution.

Loss

Data loss rates are configured as bit error rates, packet loss rates, or both. Losses due to packet loss and bit errors are emulated independently and may be combined to emulate links with physical layer corruption as well as congestion-induced packet loss.

For a lossless link, set the packet loss rate and bit error rate to 0. The default setting is for a lossless link.

Packet loss rates can be set from 0 – 100% in increments of 0.0001%.

Bit error rates can take values of $1x10^{-14}$ or greater and are entered in scientific notation. The coefficient of the rate (the field on the left) must be entered as a value greater than or equal to 0 and less than 10. The exponent may be between -1 and -14. The minus sign is supplied and only the digits of the exponent should be entered in the exponent field.

Losses are assumed to occur over the WAN link itself. Discarded packets therefore consume WAN bandwidth. For example, if a 1 Mbps link is specified to have a 10% packet loss rate, the maximum possible average throughput is 900 Kbps.

Advanced Parameters

To view and configure advanced emulation parameters, click on the *show* link next to the Advanced Parameters label. Note that even when hidden, the advanced parameter settings are used in the emulation. The advanced parameters section cannot be hidden when any of the entered values are invalid.

Queue Depth

The Queue Depth row specifies the maximum amount of data that will be buffered when data is received at a rate exceeding the emulated link rate. Any frames that arrive when the queue is full are discarded.

The queue depth can be set as a maximum numbers of packets, maximum amount of data in kilobytes, or a maximum queuing delay in milliseconds. The queue depth is specified separately for each direction. Valid entries are limited to 10,000 packets, KB, or milliseconds.

By default, the queue depth is set to 250ms. For most networks, this setting will lead to few packet drops, but the queuing delay can reach 250ms in each direction. A smaller queue depth will lead to a smaller maximum delay, but potentially more dropped packets. If possible, specify the queue depth and units to match the queuing behavior of the WAN transmission equipment on the network being emulated.

Framing Overhead

Framing overhead is the number of additional bytes required by a link-layer technology when transmitting a packet of data. Typically, the framing overhead consists of link-layer addressing and error checking information.

To emulate a link-layer technology with a particular framing overhead, select the value from the drop-down list, if available, or choose C*ustom* and enter the specific value.

To emulate the traversal of a frame over a link, the Linktropy WAN Emulator calculates the effective size of the frame as the data portion of the Ethernet frame (without the Ethernet header or FCS) plus the specified framing overhead.

The Linktropy WAN Emulator includes three choices for framing overhead:

- Ethernet (header + FCS)
  This option emulates a WAN link layer with an Ethernet-like frame of 18 bytes of header and frame check sequence (FCS). This is the default option and is a reasonable choice if the properties of the link layer are unknown.

- Ethernet (header, FCS, preamble, pad)
  This option emulates an actual Ethernet link, including the preamble and padding between Ethernet frames. Select this option to emulate an Ethernet-based WAN network.

- Custom
  This option allows the specification of any link layer framing overhead in bytes per data packet up to a maximum of 300 bytes. Select this option if the link layer framing overhead is known.

5 | BRIDGE/ROUTE TAB

Bridge and Routing Mode Configuration

The Linktropy Mini² can be installed as either a bridge or router to forward frames between the LAN A and LAN B Ethernet interfaces. By default, the Linktropy Mini² is configured as a bridge, and this mode is recommended for simplicity unless the LAN A and LAN B interfaces need to be on separate subnets.

To switch to IP Routing Mode from Bridging Mode, click on the link *switch to IP Routing Mode*. To revert to Bridging Mode, click on the link s*witch to Bridging Mode*.

Bridge/Route settings are not stored with emulation parameters and will not change when a stored emulation is loaded.

Bridging Mode

In Bridging Mode, the Linktropy device functions as a bridge between the Ethernet segments connected to the LAN A and LAN B ports. In this mode, it can forward any Ethernet-based frame regardless of network layer protocol, including IP, IPv6, IPX, and AppleTalk.

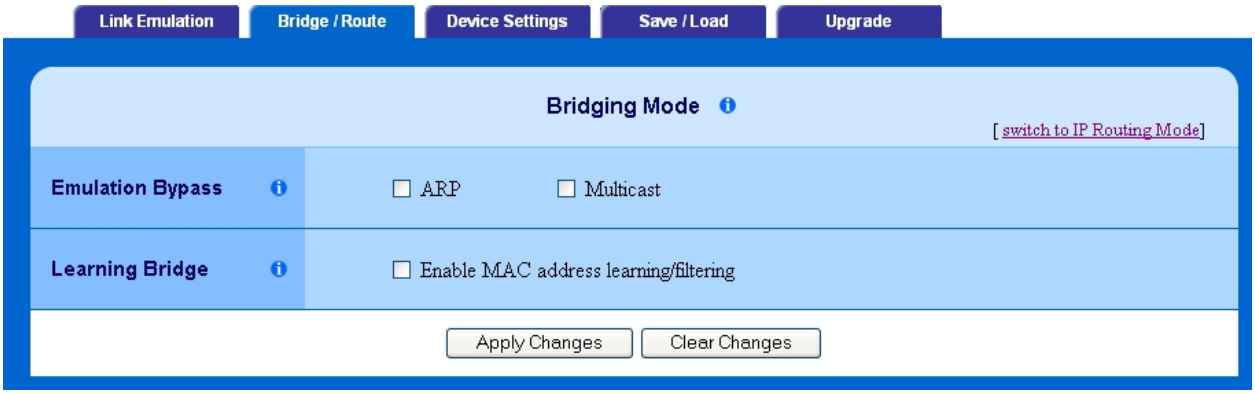

Figure 6: Bridging Mode

Emulation Bypass

By default, all frames bridged by the Linktropy device are assumed to be part of the WAN traffic and are subjected to the configured WAN link conditions. This includes ARP and multicast traffic, which may be processed or filtered prior to traversal of the WAN link.

The Emulation Bypass row is used to specify whether ARP and multicast frames are to be included as part of the WAN traffic, or bypass the WAN emulation. ARP and multicast frames will bypass the WAN emulation when the corresponding boxes are checked. Frames that bypass the WAN emulation are not subjected to loss or delay and do not consume emulated link bandwidth.

Learning Bridge

By default, the Learning Bridge feature is disabled and the Linktropy Mini² forwards all frames received on the LAN A and LAN B interfaces to the opposite side. This provides the fastest packet handling rates and highest throughput, and is recommended except when learning bridge functionality is specifically required.

When the box labeled "Enable MAC address learning/filtering" is checked, the Linktropy Mini² acts as a learning bridge and provides MAC address learning and filtering. The device examines the source MAC address of received frames to learn the network segment (LAN A or LAN B) on which each directly connected device is located. Received frames for which the source and destination devices are on the same network segment are discarded.

Learning Bridge functionality is generally only required when connecting multiple devices on a network segment through a repeater/hub. When using a switch, the switch provides the filtering functionality and learning bridge functionality is not needed on the Linktropy Mini².

IP Routing Mode

In IP Routing Mode, the Linktropy Mini² functions as a router between the Ethernet segments connected to the LAN A and LAN B ports.

IP Routing Mode provides a default routing mechanism that eliminates the need for multiple static routes. When a gateway address is set for both interfaces, the default next-hop for packets received on one interface is the gateway address of the opposite interface. For example, if a packet is received on the LAN A interface and has a destination address on a subnet that is not directly connected to either the LAN A or LAN B interface, the packet is forwarded across the emulated link to the LAN

B gateway router.

Packets that are forwarded out the same interface on which they were received do not traverse the emulated WAN link. Packets are never forwarded between the MGMT and LAN A or LAN B interfaces.

Routing Mode supports only the forwarding of IP frames and does not support multicast forwarding.

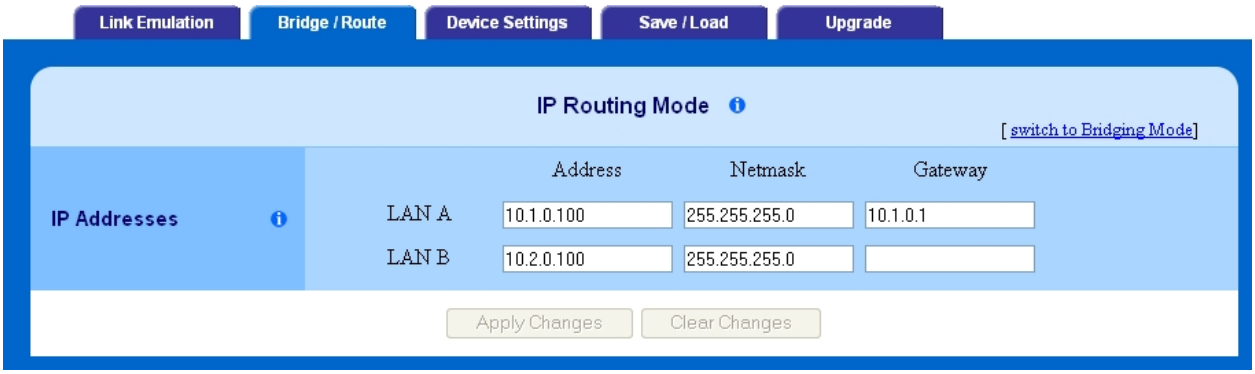

Figure 7: Routing Mode

IP Addresses

In IP Routing Mode, an IP address and netmask must be configured for the LAN A and LAN B interfaces. Use of the gateway field is optional. All addresses are entered in dotted-decimal notation.

If a gateway address is set, it must be on the same subnet as the corresponding LAN A or LAN B address. If a gateway address is set for only one interface, then the Linktropy Mini² will use this address as its default next-hop router. When gateway addresses are set for both interfaces, the default next-hop router for packets received on one interface is the gateway of the opposite interface.

The following entries are invalid:

- a gateway address not on the same subnet as the interface address
- an interface address or gateway address with an all-zeros host component
- an interface address or gateway address with an all-ones host component

If there are any invalid entries when the Apply Changes button is pressed, a red error box will be drawn around the row. Changes are not applied until the errors are fixed and the Apply Changes button pressed again.

6 | DEVICE SETTINGS TAB

Device and Interface Parameters

The device name and interface settings are configured on the **Device Settings** tab. Settings are saved by pressing the *Apply Changes* button on the bottom of the tab. Settings remain unchanged through reboots and power cycles. Device settings are not stored with emulation parameters and will not change when a stored emulation is loaded.

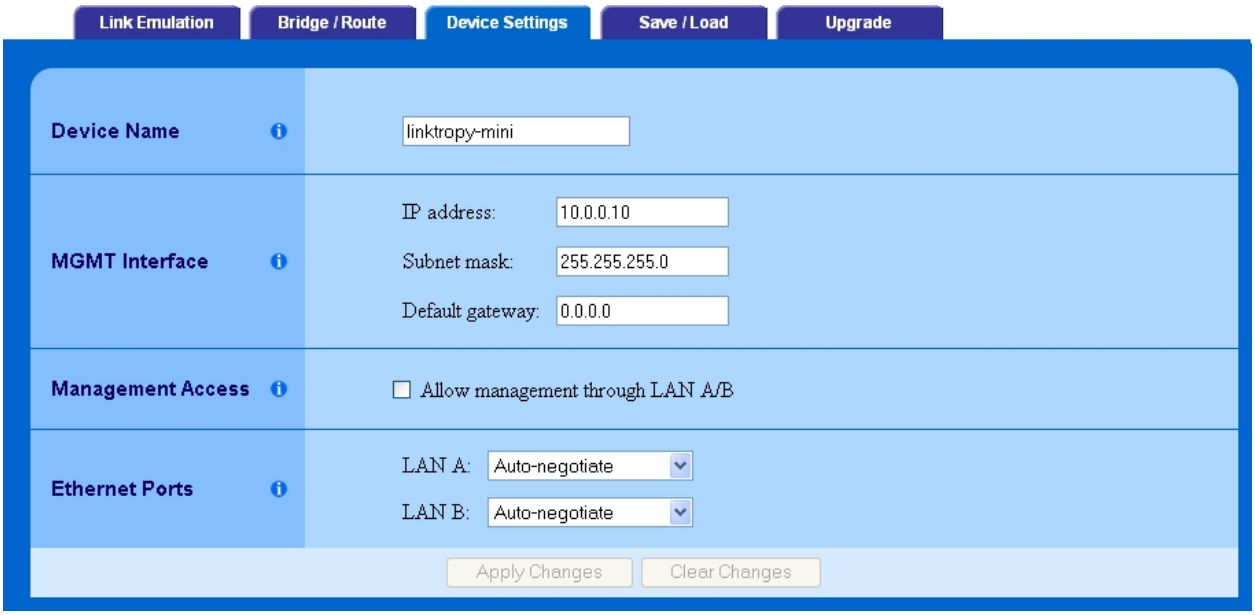

Figure 8: Device Settings Tab

Device Name

The name of the Linktropy unit is displayed and changed here. This name is also shown at the top of the Status Box and on the browser title bar.

MGMT Interface

The *MGMT Interface* row is used to set the IP address of the Linktropy management interface, the subnet mask, and the IP address of the default gateway. All values are entered in dotted-decimal notation.

If the entered IP address and default gateway address are not on the same subnet, or if either address is the all-zeros or all-ones subnet address, then a red error box will be drawn around the *MGMT Interface* row when the *Apply Changes* button is pressed and the changes will not be applied.

When the IP address of the Linktropy device is changed, connectivity to the Linktropy GUI will be lost and a link to the newly-configured IP address will be displayed in the Message Bar. If the new address is reachable from the browser, click on this link to reconnect to the Linktropy GUI.

If you cannot regain connectivity to the Linktropy Mini² after a change to the network settings, use the CONSOLE interface to verify or change the network settings

Management Access

By default, the Linktropy GUI is accessible only through the MGMT interface. Checking the box labeled "Allow management through LAN A/B" enables management from directly connected devices on the LAN A or LAN B network.

When this feature is enabled in Bridging Mode, the IP address of the MGMT interface can be reached through the LAN A and LAN B interfaces.

When this feature is enabled in IP Routing Mode, the device can be managed using the MGMT, LAN A, or LAN B interface addresses.

For maximum performance, this feature should be disabled if not required.

Ethernet Ports

The Linktropy Mini² includes three 10/100 Mbps Fast Ethernet interfaces labeled LAN A, LAN B,

and MGMT. By default, all Ethernet interfaces are set to auto-negotiate the proper speed and duplex settings. It is strongly recommended to keep the interfaces set to auto-negotiate unless auto-negotiation is not working properly.

Only the LAN A and LAN B interfaces can be set to override auto-negotiation. Use the drop-down menu to disable auto-negotiation and force the interface to a particular setting.

If full-duplex is selected manually, the device the interface is connected to must be forced to the same setting.

7 | SAVE / LOAD TAB

Save, Load, and Delete Named Emulations

Use the **Save / Load** tab to store emulation parameters to a named configuration or to reload a previously stored emulation. The **Save / Load** tab also provides the ability to rename and delete stored emulations.

Radio buttons on the left side of the tab are used to select between Save, Load, and Delete operations.

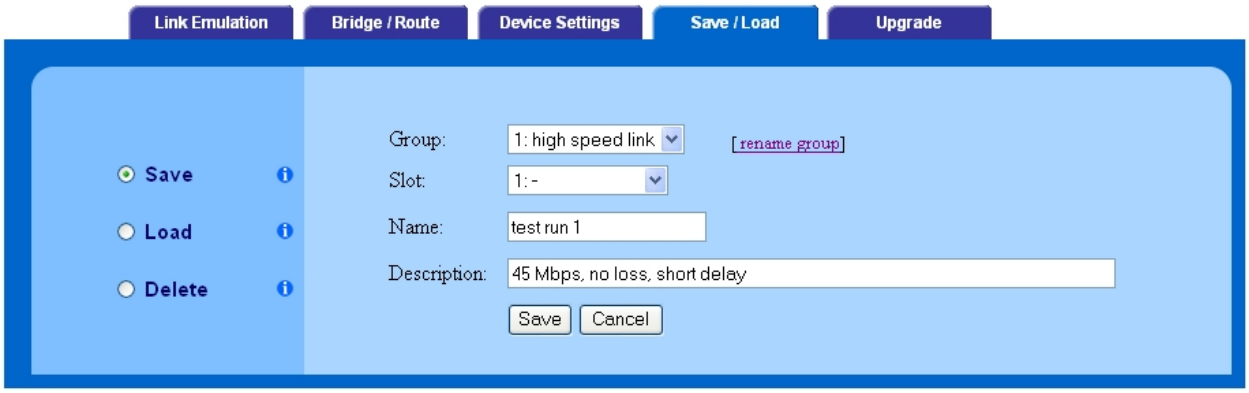

Figure 9: Save / Load Tab

☞ Save and load operations only save or load the emulation parameters from the **Link Emulation** tab. Other device configuration parameters, including the settings from the **Bridge/Route** tab and the **Device Settings** tab are not affected by saving or loading an emulation.

Save Emulation

The Save screen is used to store the current emulation parameters as a named emulation. Emulations are stored on the Linktropy device. Twenty named emulations can be stored in each of 10 groups, for a total of 200 separate emulations. Groups can be used to separate emulations by project, date, network, user, or any other criteria.

If the Save screen is not displayed, click on the *Save* radio button.

To save an emulation, first select a Group from the drop-down menu next to *Group*. Then pick a slot number from the drop-down menu next to *Slot*. Until a slot is selected, the name and description fields and the *Save* button remained grayed out. Select an empty slot or write over an existing configuration.

Once the slot is selected, the Name and Description fields become active. If an existing emulation is selected, the Name and Description of the emulation are shown and may be edited. If an empty slot is selected, the Name and Description fields are blank. The Name field must be filled in. The Description field is only for reference to record identifying details of the emulation and may be left blank.

Once the Group and Slot are selected and a Name assigned, the *Save* button becomes active. Press *Save* to store the emulation.

The preset group names of "Group 1" through "Group 10" can be changed by clicking the *Rename* link adjacent to the Group drop-down list. When the link is clicked, a name field will appear. Enter the new name and click *Apply* to set the Group name or click *Cancel* to cancel the Group rename process. Changing the name of a Group does not affect the emulations stored in that Group

Load Emulation

Previously stored emulations can be reloaded from the Load screen. Click the *Load* radio button to display the Load screen.

To load an emulation, first select the *Group* from the drop-down list. Only Groups that contain stored emulations are shown. Next, select a stored emulation from the *Name* drop-down list. The emulation description will be displayed. Clicking the *display configuration* link will show a description of the configuration in a pop-up window. If this is the correct emulation, click the *Load* button to restore the emulation.

Once the emulation has been loaded, the emulation parameters can be viewed and changed on the **Link Emulation** tab.

Loading a saved emulation overwrites the current emulation parameters. To preserve the current emulation, save the emulation before loading a new emulation.

Delete Emulation

Stored emulations can be deleted from the Delete screen. Click the *Delete* radio button to display the Delete screen.

To delete an emulation, first select the *Group* from the drop-down list. Only Groups that contain stored emulations are shown. Next, select a stored emulation from the *Name* drop-down list. The emulation description will be displayed. Click the *Delete* button to delete the selected emulation.

Once deleted, emulations can not be recovered.

8 | UPGRADE TAB

Firmware Upgrades and License Keys

Use the **Upgrade** tab to upgrade the Linktropy firmware and install new license keys.

Figure 10: Upgrade Tab

Upgrade Firmware

The firmware version currently installed on the Linktropy Mini² is displayed in the Upgrade Firmware row.

To change the version of firmware, first download the new image from the support section of the Apposite Technologies website at: http://www.apposite-tech.com. Save the firmware image on the PC running the browser or on a file server accessible from the browser.

In the Upgrade Firmware row, click the *Browse* button to find and select the image or type the name of the image, including the full path name. Then click the *Upgrade* button to install the new firmware.

A blank pop-up window will open when the upgrade is initiated. It will take at least 45 seconds for the operation to complete, at which time the result will be displayed. The new firmware will not run until the unit is rebooted.

> ☞ The same procedure can be used to restore an older version of firmware if necessary. However, when downgrading to an older release, the link emulation parameters and device settings may not be preserved.

> ☞ A support contract and associated password are required to access support resources on the Apposite Technologies website.

License Key

The license key controls the maximum WAN bandwidth that can be emulated. The Linktropy Mini² has a maximum rate of 100 Mbps.

9 | MONITOR WINDOW

Statistics and Graphs, ARP Table

The Monitor window displays link statistics, throughput graphs, and the ARP table. To access the Monitor window, click on *Monitor* to the right of the row of tabs in the Configuration window. The Monitor window will open in a separate browser window.

To switch between statistics and ARP table pages, click the corresponding link at the top of the Monitor window.

Statistics

The statistics page displays real-time statistics and throughput graphs of the traffic over the emulated link. Traffic from LAN A to LAN B is shown on the top half of the page and traffic from LAN B to LAN A is shown below. For each direction, there is a summary of the current emulation settings, a table of statistics, a graph of the transmission rate, and a table of average transmission rates. The currently running emulation parameters are also displayed.

All statistics are based on values since the last reset and are independent of whether the Monitor window has been open or not. Rebooting or power cycling the device resets all values. The reset button at the top of the page resets values for the window. After reset, transmission rates are displayed in the table only after data is available for their respective intervals.

The page display is periodically refreshed at the rate set from the drop-down menu in the upper right corner.

The *reset* button resets statistics for its browser window only. Opening a new Monitor/Schedule window will restore statistics from the last reboot or power cycle. Reloading the current window also restores all statistics.

Statistics cannot be recovered after a reboot or power cycle of the device.

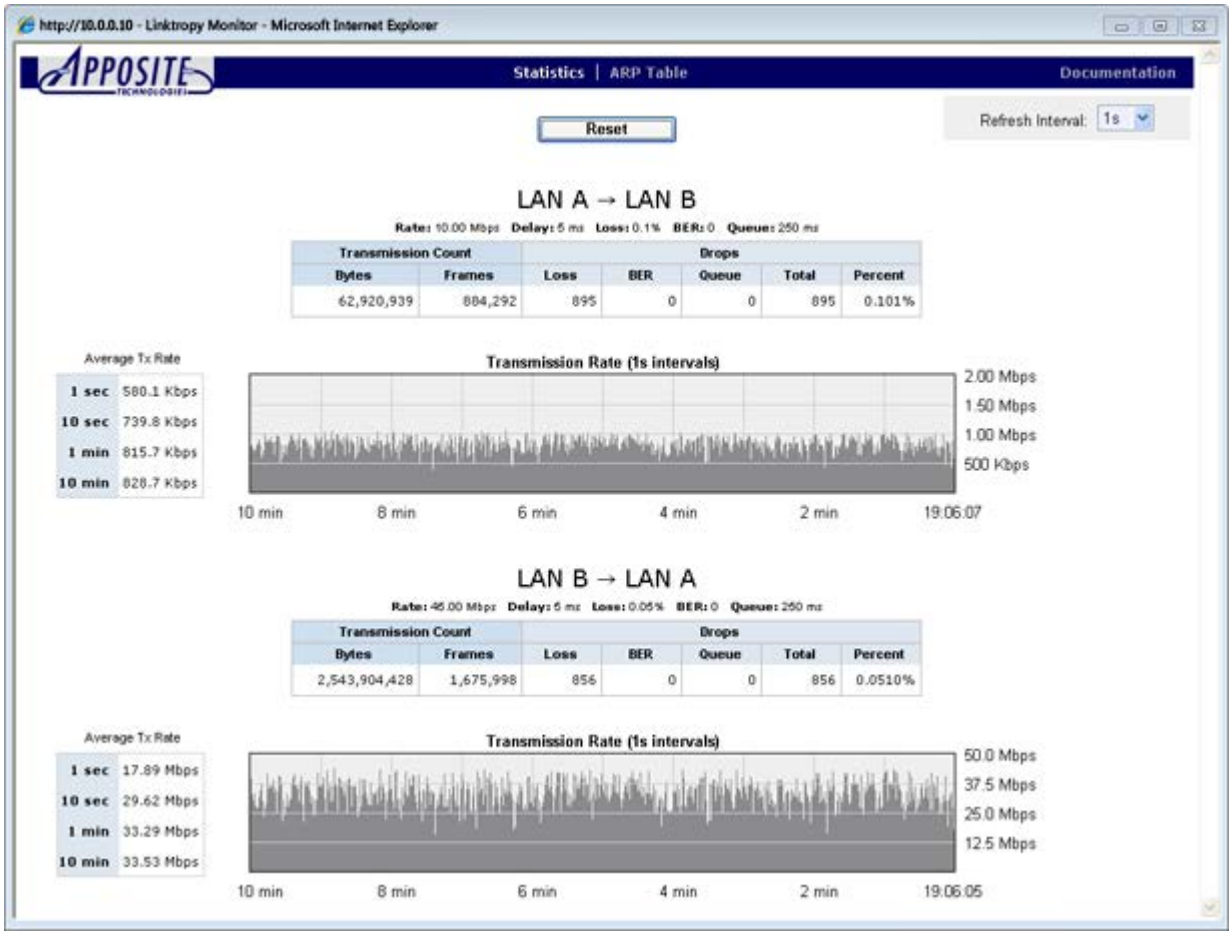
http://10.0.0.10 - Linktropy Monitor - Microsoft Internet Explorer
APPOSITE
Statistics | ARP Table
Documentation
Reset
Refresh Interval: 1s
LAN A → LAN B
Rate: 10.00 Mbps Delay: 5 ms Loss: 0.1% BER: 0 Queue: 250 ms
Transmission Count
Drops
Bytes Frames Loss BER Queue Total Percent
62,920,939 884,292 895 0 0 895 0.101%
Average Tx Rate
1 sec 580.1 Kbps
10 sec 739.8 Kbps
1 min 815.7 Kbps
10 min 828.7 Kbps
Transmission Rate (1s intervals)
2.00 Mbps
1.50 Mbps
1.00 Mbps
500 Kbps
10 min 8 min 6 min 4 min 2 min 19:06:07
LAN B → LAN A
Rate: 46.00 Mbps Delay: 5 ms Loss: 0.05% BER: 0 Queue: 250 ms
Transmission Count
Drops
Bytes Frames Loss BER Queue Total Percent
2,543,904,428 1,675,998 856 0 0 856 0.0510%
Average Tx Rate
1 sec 17.89 Mbps
10 sec 29.62 Mbps
1 min 33.29 Mbps
10 min 33.53 Mbps
Transmission Rate (1s intervals)
50.0 Mbps
37.5 Mbps
25.0 Mbps
12.5 Mbps
10 min 8 min 6 min 4 min 2 min 19:06:05

Figure 11: Monitor Window

Graphs show the transmission rate in each direction for the previous 10 minutes based on 1 second samples. The y-axis automatically adjusts to the maximum transmission rate over the period. The average transmission rates for the past 1 second, 10 seconds, 1 minute, and 10 minutes are also displayed in tabular form next to the graph.

A table of statistics displays the following real-time data in each direction:

- Transmission Count
  - Bytes: number of bytes transferred over the emulated link.
  - Frames: number of Ethernet frames transferred over the emulated link.
- Drops
  - Loss: number of frames dropped due to packet loss.
  - BER: number of frames dropped due to bit errors.
  - Queue: number of frames dropped due to configured queuing limits.
  - Total: total number of frames dropped due to loss, BER and queuing limits.
  - Percent: total number of dropped frames as a percentage of the total number of frames received.

ARP Table

The ARP Table page displays the current ARP table for the device. In Bridging Mode, the ARP table only contains entries used for device management. In IP Routing Mode, the ARP table includes entries for the MGMT, LAN A, and LAN B interfaces.

To update the display with the current contents of the ARP table, click the Refresh button at the top of the page.

10 | COMMAND LINE INTERFACE

Management and configuration of the Linktropy Mini², including the setting of all emulation parameters, is via the Linktropy GUI. The Linktropy Mini² also includes a command line interface (CLI) with a limited feature set, that can be accessed via the CONSOLE interface or through a Telnet connection. The CLI provides the following subset of the functionality available in the Linktropy GUI:

- Configure the management IP address, subnet mask, and default gateway
- Load previously stored emulations

To access the CLI either through Telnet and the CONSOLE interface, log into the device at the prompt as "`admin`". There is no password.

Multiple simultaneous Telnet sessions are allowed.

CLI Command Syntax

Command	Syntax and Description
`help`	`help or ?` Displays a list of commands available through the CLI. A question mark after any command displays the command syntax.
`ifstat`	`ifstat [<interval>]` Continuously reports the number of frames and bytes transmitted and received on each interface at the specified interval. The interval is specified in seconds and defaults to 1 sec. if no interval is specified. Use CTRL-C to stop.
`init`	`init config ["nolicense"]` Returns the configuration to factory default settings. Include "`nolicense`" to also reset the license acceptance.
`list`	`list saved` Displays a list of saved configurations, ordered by Group index and Slot index
`load`	`load {<group-idx> | <group-name>} {<slot-idx> | <config-name>}` Loads a saved configuration specified by Group and Slot. The Group and Slot may be specified by name or index. Any spaces in the name must be surrounded by double quotes.
`logout`	`logout` Logout from the command line interface. Returns user to the login prompt.

`mgmt`	`mgmt set addr <addr> netmask <mask>`
	Sets the IP address and netmask of the MGMT interface
	`mgmt set gw <addr>`
	Sets the default gateway of the device
	`mgmt show`
	Displays the IP address and netmask of the MGMT interface and default gateway of the device.

`ping`	`ping <address> [<size>]` Pings from the device to `address` with the specified sized packets. Use CTRL-C to stop.

`reboot`	`reboot` Reboots the device. Returns user to the login prompt after reboot.
`upgrade`	`upgrade <image name> <server address> ["tftp"]` Upgrades the Linktropy firmware. If the image is not located in the root directory of the HTTP server or TFTP server, the image name must include the full path name. Specify the IP address of the HTTP or TFTP server. By default, the Linktropy WAN Emulator will use HTTP to download the firmware image. Specify "`tftp`" to use TFTP instead.
`version`	`version` Displays the operating firmware version.

11 | APPOSITE SUPPORT

If you experience any problem with the Linktropy hardware, consult the *Linktropy Mini² Hardware Guide*. If you have any questions about the firmware not answered in this *User's Guide*, please check the Apposite Technologies website at http://www.apposite-tech.com for updated firmware and documentation. If your question is not answered, please contact Apposite Support.

Purchase of the Linktropy Mini² comes with ninety days of support and maintenance.

If you believe the firmware is not functioning properly, please upgrade to the latest firmware release. If the problem persists, please contact Apposite Support at:

support@apposite-tech.com
1.310.477.9955 ext. 2

When contacting Apposite Support, please include the following information:

- Linktropy model
- Serial number
- Your e-mail address and phone number
- Installed firmware version
- A detailed description of the problem

Do not attempt to fix any hardware problem yourself. The Linktropy Mini² contains no user serviceable parts. Opening the chassis voids the warranty.

APPENDIX A

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ELEXO
20 Rue de Billancourt
92100 Boulogne-Billancourt
Téléphone : 33 (0) 1 41 22 10 00
Télécopie : 33 (0) 1 41 22 10 01
Courriel : info@elexo.fr
TVA : FR00722063534

Apposite Technologies, Inc.
11500 W. Olympic Blvd., Suite 510
Los Angeles, CA 90064 USA
www.apposite-tech.com

tel: 1.310.477.9955
fax: 1.310.477.9956
email: info@apposite-tech.com